

The Examiner asserted that the art of record contains the features of the presently claimed invention and the motivation for combining the cited features in the art of record to render obvious the processes claimed. The Examiner further asserted that in the Amendment filed January 26, 1994, Applicants simply argued to the individual teachings of the references without consideration of what their collective teachings would suggest to a person skilled in the art. Applicants respectfully direct the Examiner's attention to page 9 and 10 of the Amendment filed January 21, 1994, which specifically describes how the references cited by the Examiner cannot be properly combined with the prior art of record to render obvious the presently claimed invention.

The Shishino Reference

As Applicants pointed out in the January 26 Amendment, Shishino does not disclose depositing metal to form contact holes with different depths. Shishino only discloses depositing metal in a single contact hole. Furthermore, in Shishino's process, only one insulation layer (4) is present. This process is entirely different from the process of the present invention in which a plurality of contact holes in multiple insulation layers can be made. Shishino is completely unrelated to overcoming problems associated with forming contact holes with different depths, particularly as a result of having multiple insulation layers. Shishino's objective is to form a smooth surface of copper layer on top of a tungsten layer (6) in a contact hole

because a tungsten layer grown by chemical vapor method is very hard and irregular (see Figure 2(b) of the Shishino patent). Therefore, Shishino teaches away from filling the top portion of a contact hole with a tungsten vapor deposition method.

The Tanaka Reference

The Tanaka patent is unrelated to vapor deposition. Tanaka, as Shishino, does not disclose a method for making a device with contact holes having different depths. Tanaka's objective is to etch contact holes and provide a monitoring hole at the same time. In Tanaka, all the contact holes have the same depths and are formed essentially together in similar manner. There is no contact hole that is formed after other contact holes have been at least partially filled with metal.

Prior Art in Figures 1(a) and 1(b)

Prior art Figures 1(a) and 1(b) of record show the deposition of tungsten film in a single deposition step regardless of the depth of the contact holes. Because the holes have different depths, some of the holes are not filled to the top.

Nonobviousness of the Claimed Invention

Applicants submit that the prior art of Figures 1(a), 1(b) and the references cited by the Examiner cannot be properly combined to render obvious the presently claimed invention for the following reasons.

The prior art of Figures 1(a) and 1(b) does not suggest filling the contact holes with a two-step deposition method. Further, there is no suggestion in the cited references or Figures 1(a) and 1(b) that a two-step deposition process can be practically done or even desirable. Neither Shishino or Tanaka is related to making a device wherein contact holes have different depths. Since neither Shishino or Tanaka is related to filling contact holes of different depths, there is no suggestion that they can be modified for overcoming the problem of preventing the growth of a metal layer sideways in shallow contact holes when contact holes with different depths are being filled with a metal layer. There is no indication that Tanaka or Shishino recognizes the problems associated with depositing a metal layer in adjacent contact holes that have different depths, much less suggests a solution to those problems.

Further, there is no teaching or suggestion in any of the references asserted by the Examiner (prior art Figures 1(a)-1(b), Tanaka or Shishino) that contact holes with different depths can be filled with a two-step process at all. Although Tanaka discloses filling contact holes with a two-staged method, the contact holes are all of the same depth. Filling a plurality of contact holes of the same depth is entirely different from filling contact holes of different depths. There is no suggestion by Tanaka that his method can or should be adapted for contact holes of different depths.

Even if, arguendo, assuming Shishino and Tanaka are to be combined with the prior art of Figures 1(a) and 1(b), the

resulting process will be substantially different from the presently claimed invention. As previously stated, by forming a smooth copper layer on top of a vapor deposited tungsten layer, Shishino actually teaches away from forming the top portion of a contact hole with a vapor deposition process. Because neither Shishino or Tanaka forms a top portion of a contact hole with a vapor deposition method, combining these references to modify the prior art of Figures 1(a)-1(b) will only result in a process in which each contact hole, as shown in Figure 1(a)-(d) of Shishino, has a top portion formed by a copper electrolysis plating process, which is not the claimed method.

Moreover, independent claim 4 claims a method in which the deposition of a matter in a second contact hole is subsequent to the deposition of a metal layer in a first contact hole. Applicants direct the Examiner's attention to the fact that the first contact hole is not the same as the second contact hole and therefore the second contact hole is filled subsequent to forming a first layer of metal in the first contact hole. Neither the prior art of Figure 1(a)-1(b) nor the cited references by the Examiner (Tanaka and Shishino) teaches or suggests such a method. Since none of the prior art or cited references teaches or suggests such a method, no combination of the prior art and cited references can render obvious the presently claimed invention of claim 6.

Obviousness cannot be established by combining the teachings of prior art to produce the claimed invention absent some teaching, suggestion, or incentive supporting the

combination. In re Geiger, 815 F.2d. 686, 2PQ2d. 1276 (CAFC, 1987). The mere fact that references can be combined does not render the resulting combination obvious unless the prior art also suggests the desirability of the combination. In re Fritch, 972 F.2d. 1260, 23 PQ2d. 1780 (CAFC, 1992). Applicant submit that no teaching, suggestion, or motivation is provided by the prior art of record and references.

In the presently claimed invention, Applicants discovered the solution of the problem of depositing a metal layer in adjacent contact holes with different depths lies in the deposition of a metal layer in a contact hole associated with a gate electrode before the deposition of a metal layer in another contact hole associated with a conductive layer pattern. This results in a sequential deposition of metal layers in holes of different depths.

In hindsight, with the benefit of the disclosure of the present application, it would appear to be obvious to use a two-step vapor deposition method to fill contact holes of different depths as is claimed in the present invention. However, the use of hindsight is inappropriate when considering the obviousness of an invention. The references, viewed by themselves and not in retrospect, must suggest doing what Applicants have done. In re Schaffer, 229 F.2d. 476, 108 U.S.P.Q. 326 (CCPA, 1956). Because the prior art of record and cited references (1) do not recognize the problem of filling contact holes of different depths, (2) do not suggest that a vapor deposition method can be done in a two-step process, (3) do not suggest that it is desirable to form the

top portion of a contact hole with a vapor deposition method, and (4) do not suggest that certain contact holes can be filled subsequent to the deposition of a metal layer in other contact holes, the references cannot be properly combined to render obvious the presently claimed invention.

To arrive at the presently claimed invention, one would have to forsake the convenience of forming contact holes by removing insulation layer portions in a single step as described in the prior art of Figures 1(a)-1(b), go against the teaching of Shishino that vapor deposition is not desirable for forming the top portion of contact holes, change the method of Tanaka into a vapor deposition method and add to that method a step of vapor depositing in a second contact hole subsequent to vapor depositing a metal layer in a first contact hole, all in the face of having no teaching or suggestion by any of the references that a two-step method is desirable for filling contact holes with different depths. Applicants submit that without hindsight based on the present application, a skilled art worker will not find it obvious to arrive at the above method. It would be unfair for the Examiner to summarily assert obviousness without pointing out specifically by cites the suggestion or motivation in the prior art of record and references.

In view of the foregoing remarks, Applicants respectfully submit that the prior art of Figures 1(a)-1(b), and the cited references Shishino and Tanaka cannot be properly combined to render obvious the presently claimed invention.

Accordingly, withdrawal of the rejection is respectfully requested.

Applicants submit that the pending claims of the present application are now in condition for allowance and such action is earnestly sought if the Examiner believes that any points at issue on the application could best be resolved by either a personal or a telephone interview, the Examiner is urged to contact the undersigned Applicants' attorney at the number listed below.


Respectfully submitted,

Sang Young Kim et al.

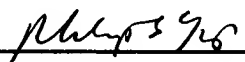
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